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Abstract

GRAIN SIZE AND MICROSTRUCTURE EFFECTS ON IRRADIATION HARDENING OF LOW CARBON STEEL FOR REACTOR TANKS

by

N. Milašin, Boris Kidrič Institute of Nuclear Sciences,
Beograd-Vinča, Yugoslavia

The grain size effect on irradiation hardening of different types of steel has been studied extensively during the past few years. However, the evidence obtained was not sufficient to answer completely to the question.

The experiments described here were performed to give a new evidence on the influence of the grain size parameter on irradiation hardening of a given type of low carbon steel for the reactor tank at integral fast flux > 10^{19} nvt and irradiation temperature below 100°C. As a part of the VISA 2/1 Project these investigations were carried out in collaboration with the Saclay Nuclear Research Center.

At the same time the experimental procedures used to obtain different grain size specimens gave different microstructures of the steel. Thus, it was necessary to deal not only with different grain sizes, but also to take into account possible influence of the microstructure obtained. Actually, it was found that the behaviour of the specimen during irradiation was more affected by microstructure than by grain size.

The most important results obtained could be summarized as to indicate: (1) different grain size specimens, having ferrite-perlite microstructure gave the same increase in a yield stress, (2) specimens with cementite precipitated at the grain boundaries have shown a much more pronounced embrittlement; after irradiation all of them fractured in a brittle manner before the plastic region has been reached, (3) the specimens treated in austenitic range to obtain large grain sizes embrittled less than the specimens deformed at room temperature and treated in ferritic range, the elongation to fracture being reduced much more in the latter case. This is also followed by a more pronounced change in the shape of the stress-strain curve of the specimens treated in ferritic range.

The annealing experiment was performed at 150°C. In general, ferrite-perlite microstructure specimens have shown a further small increase of the yield and ultimate tensile stress.